Tank Extended Range Munition (TERM) Contributions to the Battlefield

By
Mark Nicolich and Julie Chu

Weapon Systems and Technology Team, Close Combat Armaments Center
US Army Armament Research, Development and Engineering Center
Picatinny Arsenal, NJ 07876

Stan Gray

US TRADOC Analysis Center-White Sands Missile Range
White Sands Missile Range, NM 88002

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ABSTRACT

THE TANK EXTENDED RANGE MUNITION (TERM) IS A DEVELOPMENTAL 120MM TANK ROUND FOR THE M1A2 ABRAMS MAIN BATTLE TANK, WHICH WILL EXTEND THE MANEUVER COMMANDER'S RANGE BEYOND 8 KILOMETERS. TERM WILL LEVERAGE SITUATIONAL AWARENESS (SA) AND DIGITAL MESSAGING BY EMPLOYING PRECISION FIRES BEYOND LINE OF SIGHT (BLOS) ON TARGETS IDENTIFIED WITH FAR TARGET LOCATION SYSTEMS. TERM WILL BE CAPABLE OF AUTONOMOUSLY ENGAGING LINE OF SIGHT (LOS) TARGETS BEYOND THE LIMITS OF CURRENT TANK ROUNDS. TERM WILL PROVIDE THE ARMOR MANEUVER FORCE WITH A MAJOR ADVANCE IN COMBAT LETHALITY AND SURVIVABILITY FOR EXISTING AND FUTURE WEAPON PLATFORMS. CURRENTLY, THE US ARMY TACOM-ARDEC IS DEVELOPING TWO UNIQUE PROJECTILE CONCEPTS WITH TWO INDEPENDENT CONTRACTORS TO MEET USER PERFORMANCE REQUIREMENTS. NUMEROUS COMPUTER SIMULATIONS HAVE BEEN CONDUCTED IN THE COMBINED ARMS & SUPPORT TASK FORCE EVALUATION MODEL (CASTFOREM) AND BATTLEFIELD ENVIRONMENT

WEAPONS SIMULATION SYSTEMS (BEWSS) DEMONSTRATING THE UTILITY OF TERM. THE CONCLUSIONS WERE THAT TERM PROVIDES AN OPERATIONAL INCREASE IN COMBAT EFFECTIVENESS IN BOTH LETHALITY AND SURVIVABILITY FOR AN ARMOR FORCE, BY KILLING THE THREAT QUICKER AND PROVIDING MORE LONG-RANGE ENGAGEMENTS.

Background

Recent advances in threat protection (i.e. Explosive Reactive Armor (ERA) and Active Protection Systems (APS)) will continue to reduce the overmatch advantage currently enjoyed by the M1A2 Abrams tank. The proliferation of technology to retrofit existing tank systems of potential adversaries, with these advanced technologies, will reduce our technological advantage. To counteract this decline, new technologies in target acquisition sensors, digital communications, and smart munitions, when employed with new Tactics, Techniques, and Procedures, can be coupled synergistically to extend the maneuver commander's battlespace, engage high payoff targets, and assure decisive victory.

There are over 50 countries in the world today that have 300 or more tanks of T-55 or better equivalent quality. In most cases these tanks have upgrades to one or more systems that will keep them viable into the 21st century. These modifications include new drive trains, reactive armor and active protection, digital applique, and modern cannon and fire control. The open arms market also offers tank-fired ATGM for all of these tanks. Other modern ATGM are available to be mounted on or carried by a wide variety of armored vehicles. Many of these ATGM's have ranges in excess 5,000m and are capable of penetrating some of the most modern passive and reactive armor. In the very competitive arms market, it is almost certain that the proliferation of these systems will become even more widespread and that the capabilities of these weapons will continue to improve.

The Tank Extended Range Munition (TERM) concept will provide the Armor Maneuver Force a major advance in combat lethality and survivability from existing weapon platforms. TERM capitalizes on recent large Army investments in digitization and situational awareness by utilizing the expedient transfer of forward target location data to a firing platform to effectively engage high payoff targets. TERM is a new munition concept planned for the M1A2 tank and will extend the maneuver commander's lethal battlespace beyond line of sight (BLOS) to more than 8 Km. TERM will also have a limited capability to work with an M1A1 tank. TERM exploits the capability of Scout vehicles to identify and locate targets at greatly extended ranges, as well as pass digitized targeting information, in real time, to the maneuver commander or shooter.

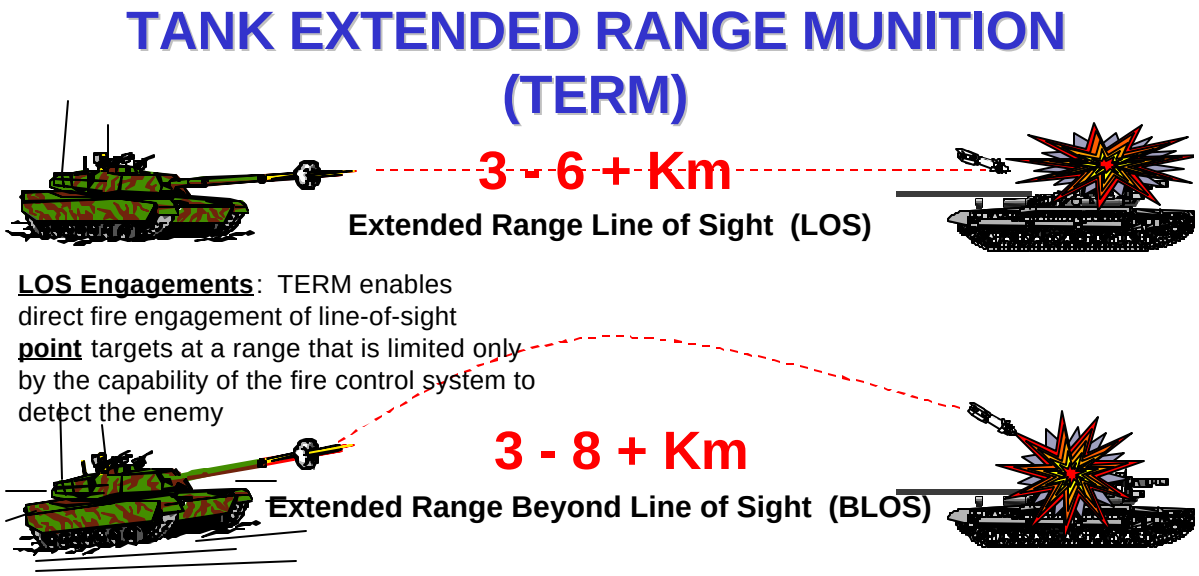
TERM will provide the mounted task force commander with a tool to shape his battlespace and engage the enemy beyond the line of sight of the enemy's tanks and current anti-tank guided missiles. Additionally, TERM will fully function as stand-alone tank weapon system for direct line of sight (LOS) and extended range line of sight engagements. The full tactical benefits of TERM, however, will result from using TERM as a component of a precision engagement/dominant maneuver system. This system will include the tank itself, Scout, COLT/STRIKER, Air Scouts, Future Battle Command Brigade and Below (FBCB2), and the Advanced Field Artillery Tactical Data System (AFATDS). Task-Force scouts will detect and acquire enemy forces well forward of tanks and infantry. Through automated target acquisition, identification, and tracking, the scouts will digitally transmit the locations of high value targets to the Task-Force and supporting elements, linking to FBCB2 and AFATDS over the tactical internet. These automated targeting systems will determine which tanks are in the best position to engage this target or determine if the target is already being serviced by another system.

The range differential between TERM and current US conventional tank fired munitions (more than 5 km) will enable the battalion to begin the engagement well before opposing tanks close to direct fire range. The same sensor-to-shooter links that enable TERM engagements will also enable scouts to direct other fires such as artillery and aviation. These long range fires will shape the battlespace at brigade and below, either preparing the enemy for defeat through the shock action of an armored assault or by isolating and removing key components of the enemy force before it moves into battalion and company sized engagement areas. As the opposing forces close, the battalion's tanks will rapidly mass against enemy weakness, to complete the destruction of the enemy with conventional, direct fire ammunition and the close combat capability of the battalion's infantry. TERM will be principally in battalion and brigade battlespace. TERM will enable battalion and brigade commanders to apply simultaneous, destructive, and paralyzing fires. While normal LOS depends on direct fire systems to destroy enemy forces at close range, TERM will strike more deeply, extending the destruction through the depth of the enemy's tactical formation. Complementing these tank fires, field artillery, aviation, and other aerial firepower will destroy key enemy support and control nodes, and isolate the engagement area from reinforcement or other assistance. Long range TERM fires will strip away enemy reconnaissance and security forces and seek out enemy command and control nodes. TERM will enable the raiding force to strike its intended target without revealing the size or composition of the raiding force. This will enable a smaller raiding party, and will sometimes enable the raiding party to operate beyond range of conventional artillery munitions.

The TERM firing sequence will work as follows: There is a scout some distance ahead of the Tank force. It could be a forward observer, scout, helicopter, or an unmanned aerial vehicle. The scout identifies an enemy target; it could be a tank, reconnaissance vehicle or other high value target. The scout calls for fire through the Advanced Field Artillery Tactical Data System (AFATDS). AFATDS selects a tank to fire the mission based on availability and terrain interference. If the target is moving or stationary, an

update of the target position is sent directly to the tank from the Scout. The round is fired, the sensors turn on and detect the target. The round maneuvers to hit and defeat the target.

TERM's key requirements include the ability to be fired (LOS, Extended Range LOS and BLOS) in both autonomous and designated modes, defeat heavy armor, and be countermeasure and APS resistant. The US Army Armor Center at FT. Knox has developed an Operational Requirements Document (ORD) for 120 mm tank Ammunition. Annex G (draft) to this ORD contains specific classified and unclassified TERM requirements.



TERM is currently a Science and Technology Objective (STO) with a planned fielding date of FY10. There are currently two competing concepts for this mission. A rocket assisted Kinetic Energy concept by Alliant Techsystems and a Chemical Energy concept by Raytheon TI Systems.

Analysis

The TERM study and analysis were initiated jointly in 1996 by Army Research Lab (ARL), the Missile Research Development and Engineering Center (MRDEC), Tank and Automotive Research, Development and Engineering Center (TARDEC), and the Army Armament Research, Development and Engineering Center (ARDEC). Since then Combined Arms and Support Task Force Evaluation Model (CASTFOREM), Battle Environment Weapon System Simulation (BEWSS), Modular Semi-Automatic Force (ModSAF) simulations were utilized to investigate TERM's effectiveness and contribution to the battlefield. TRADOC Analysis Center, White Sands Missile Range (TRAC-WSMR) and ARL were employed to simulate various TERM alternative concepts. Only CASTFOREM and ModSAF studies in three different analysis phases are presented in this report.

1. Purpose:

   Phase I - To investigate various types of TERM concept capabilities and contributions to the battlefield.

   Phase II - To determine effects of TERM on the battlefield w/wo other potential systems.

   Phase III - Simulation support to Source Selection Board in 1998 and 1999 to identify which candidate had highest potential.

2. Assumptions:

Tanks engage enemy tanks as their first priority. The scouts were the only assets which could call to the tanks to shoot the TERM in a beyond line of sight (BLOS) mode. The communication (commo) architecture was conservative in that no other assets could call for TERM fire. Basic load for each tank is 23 kinetic energy (KE), 11 High Explosive Anti-Armor (HEAT) and 8 TERM rounds.

As shown in the figure below, the Scout had a direct fire channel with tanks in their battalion and provided sufficient targeting information which enabled BLOS TERM engagements. In addition, scouts provided target acquisition passed up through the battalion tactical operations center for both general and direct support artillery.

3. Phase I Study

a. TERM ModSAF simulation by ARL

The TERM Front End Analysis was an effort by ARL to show that the TERM concept was worthy of further consideration. The Modular Semi-Automated Forces (MODSAF) model was used to simulate three different cases with and without TERM. These were a base case without TERM, a TERM case with direct fire capability only, and a TERM case with both direct fire and beyond line of sight capability. The Blue force consisted of fourteen M1A2s in a tank company and a battalion scout platoon of six surrogate Scout Vehicles. A six Scout vehicle platoon was selected rather than a platoon of ten to reflect the current thinking of the Armor Center (to replace 10 less capable High Mobility Multipurpose Wheeled Vehicles (HMMWV) with six Scout Vehicles).

Results from the MODSAF runs showed that a TERM munition increased blue force effectiveness as can be seen from the loss exchange ratio (LER) chart above. A TERM munition with both LOS and BLOS capability was more effective than one which could engage LOS only since it allowed Blue to kill the Threat before it could get within range to engage the Blue force. Additionally, LOS/BLOS capability also improved scout survivability since Blue tanks could support their scouts much quicker.

b. TERM CASTFOREM simulation analysis by TRAC-WSMR

Alternatives:

There were four primary types of TERM rounds examined. The LOS kinetic energy (KE) was a LOS-only hypervelocity round and was not affected by enemy active protection systems. The remaining three rounds could shoot in both a LOS and BLOS mode. The chemical energy (CE) round was similar to a TOW IIB round in that it was a top attack round. The explosively formed penetrator (EFP) was based on the now expired smart target activated fire and forget (STAFF) program, but with the added assumption that it could be used in a BLOS mode. Both of these rounds were susceptible to the enemy active defense. Finally, the KE bullet was a hypervelocity XROD round that was rocket assisted to attain its high speed. Because of this speed, it was not affected by enemy active defense. The alternatives investigated are listed below:

- APDS (829E4) - Base Case Tank munition
- LOS KE Missile

- BLOS and LOS EFP Bullet
- BLOS and LOS CE missile
- BLOS and LOS KE Bullet

It was decided that the Base Case tank would have futuristic capabilities beyond even the M1A2 SEP. The main cannon was the XM291 with a 5KM KE round. The target acquisition was primarily a millimeter wave (MMW) with a 3d Generation forward looking infrared (FLIR) as the Gunner's Primary Sight. Additionally, the tank had a very good active defense system that would intercept and destroy incoming enemy rounds. The scout was the up-armored HMMWV and was given a low-observable capability.

Scenarios:

The two scenarios, HRS 52 and HRS 31, used in the Phase I analysis were TRADOC standard scenarios and are described below.

In HRS 52, Blue armored brigade attacks with one mechanized (mech) task force (TF) and one armor TF abreast in the lead and a pure armored battalion in trail as brigade reserve. Red is in a hasty defense with two battalions forward and one battalion back. The forward battalion TFs are armored with attached mech infantry companies. Red brigade's reserve is an armored company from the rear armored battalion. Red brigade's remaining infantry company and antitank company are southeast of the eastern-forward armored TF. Concept of operation for Blue forces is to defeat the forward-western TF and rear armor battalion and reserve. Enemy must not be able to conduct a cohesive defense and place accurate direct fire on the division passage lane.

HRS 31 is a deliberate attack by a Blue mech brigade in Northeast Asia (NEA). Threat forces were in a prepared defense occupying strong point positions throughout the sector along a main supply route leading to the enemy capital. These positions are replete with complex obstacles intended to delay and block Blue forces. The Threat maneuver forces have been involved in previous battles and reduced in strength by aerial and ground bombardment. However, the Threat artillery remains very potent.

Blue initiated the attack with artillery preparatory fires, augmented by an attack by Apache helicopter, into all of the Blue objectives. These two elements virtually eliminated Threat armor in Threat units that were targeted as the immediate objectives.

The primary Threat to the Blue force is Threat artillery, especially while Blue conducts minefield breaching to assume positions for the final sweep across all

objectives. The use of Threat precision artillery munitions contributes greatly to Blue losses. Nearly 50 percent of Base case Blue losses are inflicted by Threat artillery.

The battle ends when the Blue forces reach the final objectives.

The long-range acquisition sensors used in this scenario were:

1) One counter battery (CB) radar for each side
2) One unmanned aerial vehicle (UAV) for Blue and one remotely piloted vehicle (RPV) for Threat. The basic difference being flight time for each system. The Blue UAV had a longer loiter time and a smaller target location error than Threat RPV.

HR 31 & 52 Results:

CASTFOREM Phase I results showed that the TERM candidates had a payoff in increased lethality as measured by Loss and Exchange Ratio (LER). Additionally, TERM had a positive effect on force survivability reducing tank losses by as much as 63 percent. Of all the TERM candidate munitions, the KE LOS/BLOS was the best overall performer. The BLOS capability gave it extended range over the LOS KE candidate munition and was not susceptible to enemy active protection system (APS). The LOS/BLOS EFP and CE munitions also performed better than the LOS-only candidate which demonstrated the value of having both LOS and BLOS capability.

Phase I Conclusions and findings:

TERM candidates have an operational payoff in increased lethality at extended ranges over the base case. TERM increases force survivability reducing tank losses by as much as half. APS reduced TERM effectiveness for slower-moving candidate munitions. TERM LOS/BLOS combined capability proved to be more effective than LOS only. KE LOS/BLOS TERM proved to be the best overall performer.

4. Phase II Study

CASTFOREM was the only simulation utilized during the Phase II TERM study.

Alternatives:

Alternatives were designed to capture the effects of (1) TERM's increased range over base case munitions, (2) TERMs LOS and BLOS engagement capability, and (3) whether shoot-on-the-move capability increases effectiveness. In addition, TERM results were compared to the effectiveness of other anti-armor weapons such as PGMM, FOTT, and EFOGM as well as the change in effectiveness when TERM is added to the brigade along with each of these systems. The alternatives are as follows:

- Base Case 2006 vs 2011(6 SCOUT VEHICLE per TF)
- Base Case + TERM 8KM range & shoot on move
- Base Case + TERM shoot on move
- Case #3 + TERM no shoot on move
- Case #3 + PGMM in Mortar Platoon (TERM)
- Base Case + PGMM in Mortar Platoon (No TERM)
- Case #3 + FOTT replace TOW for BFV's (TERM)
- Base Case + FOTT replace TOW for BFV's (No TERM)
- Case #3 + EFOGM platoon added (TERM)
- Base Case + EFOGM platoon added (No TERM)

Munition Key Comparisons:

For this Phase II effort only one type of TERM was simulated (the LOS and BLOS KE missile). There were three other anti-armor munition technologies examined in the Phase II analysis. These were the PGMM, FOTT, and EFOGM, as listed on the slide. As can be seen, TERM was the only round which allowed for both LOS and BLOS engagements. Additionally, because these were tank heavy scenarios, there were many more TERM rounds than any of the other candidate rounds. The different munitions performance characteristic are listed below:

- TERM
  - 8-10 KM range
  - 116 tanks with 8 rounds each = 928 rounds

  - Mode: LOS and BLOS
- PGMM
  - 12KM range
  - 18 Fire Units with 20 rounds each = 360 rounds
  - Mode: BLOS Only
- EFOGM
  - 15KM range
  - 12 Fire units with 8 rounds each = 96 rounds
  - Mode: BLOS Only
- FOTT
  - 5KM range
  - 58 BFV's with 5 rounds each = 290 rounds
  - Mode: LOS Only

Scenarios:

HRS 58 (Hasty Defense with a Counter-attack in Southwest Asia) and HRS 37 (Attack in Europe) were used to examine the operational effectiveness of TERM in Phase II. The Phase II tank simulated the 2006 M1A2 SEP and scouts vehicle were at the battalion level (6 total per battalion size TF).

In HRS 58, Blue indirect fires generated by reports from Blue scouts initially engage threat reconnaissance patrols, followed closely by combat reconnaissance patrols (CRP), of the lead battalions. As the Blue mech TF scouts disengage, the Threat force is engaged by forward combat elements of the Blue force at approximately 3.5 kilometers. The Threat deploys a UAV over the Blue battle position. Based on reports from the CRPs, the two lead Threat tank battalions begin to deploy into a wedge in preparation for an assault on Blue locations to their front. As the CRPs continue to call for fire on the Blue forward element, Threat scouts attempt to bypass the position on both flanks.

The Blue mech TF had approximately 30 minutes to set up a hasty defense. The Blue commander deploys two UAVs to determine the disposition, size and intent of the enemy force. The two armor heavy TFs of the Blue brigade are traveling abreast in a northerly direction approximately 10 kilometers back from the forward TF. TF scouts are deployed forward to provide reconnaissance. The scouts arrive at their recon positions just as the Threat scouts are approaching. Scouts call for indirect fire causes the destruction of most of the Threat scouts and few losses to the Scout Vehicle from Threat scout direct fires. Remaining Threat

scouts filter through but are destroyed as they come within direct fire range of lead elements of the armor heavy TFs.

As the Threat deploys, the lead armor battalions move into positions for the ensuing assault; a company of AH-64 Apache helicopters is deployed on the east flank of the Blue mech TF to demonstrate a strong right flank. The Threat fixing force is decisively engaged by the helicopters and elements of the Blue mech TF. As the Threat forces close to within 3 to 6 kilometers of the Blue hasty defensive positions, they take heavy losses from tanks, Bradley Fighting Vehicles (BFVs) and Apache helicopters.

The Threat armor battalion is engaged with the majority of systems from the Blue mech TF and takes substantial losses from direct and indirect fires. The other lead Threat tank battalion continues to maneuver south without receiving effective fire. Based on what the Threat commander perceives as success to his right front, he moves the second echelon battalions to the west with the intention of massing three battalions against the exposed flank of the Blue mech TF. At this time, the Threat brigade commander has no indication of Blue forces on his right flank other than heavy losses of flank security elements.

With Scout Vehicle calls for artillery fire, Blue is successful in defeating the Threat scouts, allowing the Blue brigade commander to position two armor TFs to arrive at masked assault positions undetected. Once the Blue brigade commander is sure the Threat second echelon has committed into his engagement area, he commits his counter attack forces into the Threat right flank.

During this portion of the battle, direct fire systems begin to dominate the attrition totals. Threat and Blue forward observers are requesting close support artillery for most of the second phase of the battle.

The Threat brigade commander commits his second echelon battalions with the intent of destroying the exposed mech TF and seizing the ground they occupy. The Threat brigade commander is still unaware of the Blue armor TFs moving into the flank of the Threat second echelon. The first echelon of the Threat brigade becomes combat ineffective at this point. The Blue counterattack succeeds and the armor TFs roll up the Threat's right flank until Threat is destroyed.

The HRS 37 scenario took place on rolling vegetated terrain in Europe. The average engagement range was 2825 meters (Base alternative tank average range).

OBSERVATION and FIELDS of FIRE: Several prominent terrain features and an abundance of vegetation on hill tops limited observation and fields of fire to less

than 3000 meters. Several inter-visibility lines restricted fields of fire to less than 1000 meters.

COVER and CONCEALMENT: Terrain provided adequate cover without significant improvement with engineer assets. Terrain and vegetation provided covered and concealed routes to Blue assault positions.

OBSTACLES: All of the terrain in sector could be traversed. However, slow go terrain on the elevated heights canalized enemy into definable avenues of approach.

AVENUES of APPROACH: The area of operations was 38 percent rolling vegetated terrain with some relief (minimum/maximum elevation = 209/657 meters) that could pose a deterrent to mobility, however roads throughout the area provided mobility corridors and avenues of approach.

WEATHER: Clear, spring day with a 5-kilometer visibility.

The scenario portrayed a Blue mech brigade attacking a Threat regiment in European terrain. The main Threat force consisted of three mech battalions. The Threat force conducted its movement with the battalions traveling in march columns. The Threat force mission was to conduct a movement to contact to pass through the first echelon of the division.

The Blue force consisted of a brigade-sized element of three mech infantry TFs. Combat support assets provided support to the brigade. The mission of the Blue force was to conduct an attack to destroy enemy forces. It was the intent of the Blue brigade commander to inflict maximum damage to the Threat force as it moved south.

The scenario began after Blue scouts maneuvered in a covered approach to reach dominant terrain and begin zone reconnaissance. Threat started moving south in parallel march column formations. Scouts made contact with the enemy, and Blue started moving north in wedge formations. Also, in this pre-battle phase, a Blue UAV began orbiting in a figure eight throughout the battlefield, increasing the Blue commander's situational awareness and destroying targets of opportunity with Blue artillery fires. Both Blue and Threat reserve battalions were positioned to wait for a commitment later in the battle.

HRS 58 Results:

TERM increased Blue force effectiveness (as shown in the LER chart) by allowing Blue to begin engagements sooner in the battle and attrit Threat at longer ranges. All other munition candidates, PGMM, FOTT, and EFOGM, also improved Blue force performance but to a lesser degree. When combined with TERM, all the other candidate munitions helped increase Blue force lethality and survivability over that of each TERM alternative. However, relative to the base alternative, TERM contributed the most significant increase in LER with improvement from between 63 percent in the **TERM(8km)** alternative to 113 percent in the **TERM(10km)** alternative.

The tank system exchange ratio indicates the contributions TERM made specifically to Blue tank performance. The Blue commander was able to control more maneuver battle space due to LOS and BLOS capability and range advantage of TERM over the base case tank munitions. This allowed Blue tanks to kill Threat armor systems while remaining out of Threat direct fire range. The other candidate munitions added lethality to the Blue force but Blue maneuver forces still had to close with the enemy before they began engagements.

Tank shots contributed to the majority of Threat maneuver losses as shown in the Red Maneuver Losses by Blue Munitions chart. FOTT, PGMM, and EFOGM were all lethal and contributed to Threat losses when in the battle but TERM proves to be most lethal contributing from 42 percent to 47 percent of total Threat maneuver kills.

On the Blue Maneuver Losses chart TERM showed a high payoff in Blue maneuver force survivability. TERM made the Blue maneuver force less vulnerable to Threat direct fire due to the extended range LOS and BLOS capability.

The majority of TERM engagements were fired at BLOS targets and more engagements occurred in the TERM 10-kilometer alternatives than the TERM 8 kilometer alternative. This is due to the extended range of TERM, which allows the tanks to engage more targets at further ranges in the BLOS mode. LOS engagements were not affected as much since engagements were a function of the tank sensor capability and the gunner's ability to recognize enemy targets at extended ranges. However, LOS engagements did occur at greater ranges than those given by base case tank munitions.

HRS 37 Results:

LER in this scenario indicates the Base alternative to be statistically different from all the other alternatives. Scouts requested Blue tanks to shoot TERM early in the battle due to their extended range engagement capability. That capability increased Threat attrition as well as Blue survivability. Scouts also called for EFOGM and PGMM in those alternatives. EFOGM, PGMM and FOTT belong to group 2 (G2), which were statistically different from the Base and the alternatives with TERM. There was an improvement of 27, 30 and 31 percent, respectively, in LERs over the Base alternative. However, when TERM was introduced to these alternatives, LERs were significantly increased by approximately 85 to 128 percent. However, EFOGM+TERM was the most effective case. In this case a company of EFOGM was added to the TERM alternative, so more rounds were available, and EFOGM had a range greater than TERM, thus more Threat were attrited.

All the TERM alternatives belonged to G2 in the tank system exchange ratio (SER), having no statistical difference between them. TERM's advantage of having both LOS and BLOS modes and enhanced range demonstrated a pronounced SER (more than 16 times more effective) over the non-TERM alternatives. The tank SER in the TERM-No Move alternative out-performed all the alternatives by at least 15 percent. The terrain constraints in this scenario allowed more accuracy and visibility while the tank was stationary, thus increased the ability to destroy maneuvering Threat.

Scouts called for TERM early in the battle, contributing 49 to 60 percent of Threat maneuver force kills. FOTT, EFOGM and PGMM anti-armor weapons showed an increased effectiveness to Threat maneuver kills throughout the alternatives. However, when TERM was introduced to these alternatives, maneuver kills by the candidates were decreased, due to TERM's edge in quantity, rate of fire, and lethality over the candidate weapons. However, damage assessment increased when EFOGM, FOTT and PGMM were added to the TERM alternative.

Blue maneuver losses depicts losses of the tank (M1) and BFV (M2). When EFOGM, PGMM and FOTT were added to the Base alternative, there were 12.1, 12.3 and 18.5 percent reductions in maneuver kills, respectively. When TERM was introduced, Blue maneuver losses dropped over 49 percent due to TERM's lethality and range. The FOTT+TERM alternative had less maneuver kills due to both the tank's and BFV's extended range, thus improved their survivability by remaining out of Threat's range early in the battle.

The above figure depicts the total engagements that occurred when TERM munition came into play. TERM's advantage of having both LOS and BLOS capabilities showed an improvement in lethality and tank kills. TERM-No Move had the most engagements. TERM had more engagement opportunities early in the battle due to scouts taking advantage of their extended range. BLOS engagements accounted for 62 to 74 percent of all TERM engagements. Both TERM and TERM-No Move alternatives fired more shots than the TERM(8km) alternative (over 14 percent) due to the additional two kilometer range advantage.

Phase II conclusions and findings:

FOTT, EFOGM and PGMM anti-armor weapons showed a considerable contribution to Threat kills and Blue survivability throughout the alternatives compared to the Base alternative. However, when TERM was introduced to these alternatives, maneuver kills by the candidates were decreased due to TERM's edge in quantity, rate of fire, and lethality over the candidate weapons.

Extended range and LOS & BLOS modes played an effective part in the Tank's survivability and lethality, which in turn trickled down to the survivability of the entire Blue force.

In HRS 37, the tank in the TERM-No Move alternative performed better than in the TERM alternative (shoot-on-the-move) because of terrain constraints. It allowed more accuracy and visibility when stationary, thus killing more and shooting less.

In HRS 58, the TERM alternative showed increased survivability for Blue maneuver forces over the TERM-No Move alternative and an improvement in Blue force effectiveness as measured by LER over both the TERM-No Move and TERM(8km) alternatives.

5. Phase III

Same methodology and CASTFOREM was used to identify and evaluate which TERM concept candidate from different contractors had the highest potential to meet the Source Selection Evaluation Board selection criteria. Due to the sensitivities of the competitiveness, the results are not presented in this report.

Conclusions from all the analysis to date

M1A2 SEP tanks with TERM and a Scout System significantly increases the combat power of the Battalion Task Force. TERM effectively enables the Battalion/Task Force commander to control an extended battlespace and set the conditions for decisive operations.

Current and Future Analysis to support TERM STO and ORD

- SSPK Analysis
- Communication timelines
- Velocity Analysis to evaluate moving targets vs stationary targets
- Evaluate TERM in Europe ACR new scenario with Armor/SCOUT VEHICLE
- Couple costs with effectiveness

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